

Development of the Three-Dimensional Track Imager (3-DTI) for High Sensitivity Medium-Energy Gamma-Ray Polarimeter

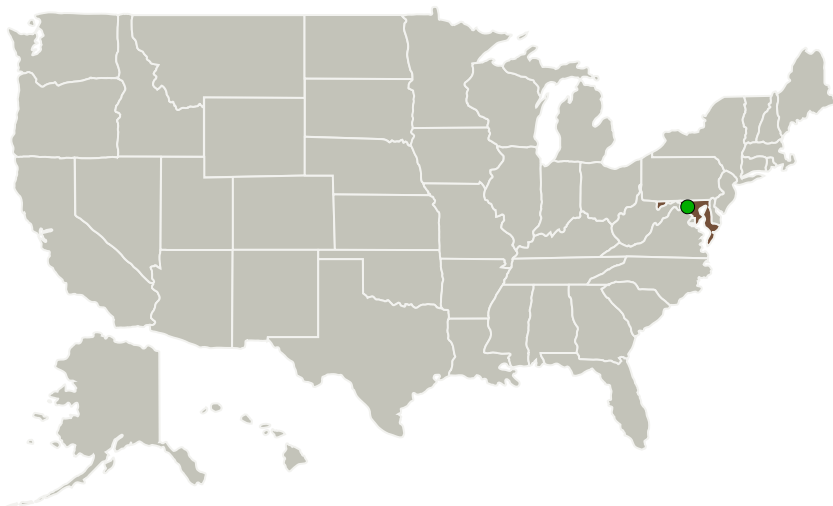
Completed Technology Project (2014 - 2018)



Project Introduction

We propose to complete development of the Three-Dimensional Track Imager (3-DTI) detector. The 3-DTI development is motivated by the diverse science goals of the Advance Energetic Pair Telescope (AdEPT); a future instrument for medium-energy gamma-ray polarization. AdEPT will provide exceptional angular resolution approaching the kinematic limit for nuclear pair production (~ 2 deg at 30 MeV) over the energy range from ~ 5 MeV to >200 MeV and will be the first instrument in this energy range to be sensitive to gamma-ray polarization. The AdEPT performance can only be achieved with a low density pair-production medium coupled with high resolution electron-positron tracking and energy determination, i.e. accurate measurement of the electron-positron recoil momenta. The 3-DTI detector combines a gas time projection chamber (TPC) with a 400 μm pitch two-dimensional Micro-Well Detector (MWD) to provide the high resolution three-dimensional charged particle tracking needed for AdEPT. The proposed work will address the need to tile smaller 12-25 cm^2 MWDs together to achieve larger, 50 x 50 cm^2 and 1 m^2 areas, explore additive manufacturing of MWDs, and measure the long-term MWD performance. We will build a 50 x 50 x 100 cm^3 active volume AdEPT prototype that will include zero dead-time streaming mode readout and charge integrating front-end electronics. Software will be developed for this prototype to discriminate between gamma-ray interactions and charged particles, determine the electron energies from multiple scattering and energy loss, and determine the incident direction and polarization of medium-energy gamma-rays.

Primary U.S. Work Locations and Key Partners



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Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Responsible Program:

Astrophysics Research and Analysis

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Organizations Performing Work	Role	Type	Location
● Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations

Maryland

Project Management

Program Director:

Michael A Garcia

Program Manager:

Dominic J Benford

Principal Investigator:

Stanley D Hunter

Co-Investigators:

Andrey Timokhin
Teresa B Sheets
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Francesco Longo
Lorenzo M Iparraguirre
Andrei R Hanu
John F Krizmanic
Georgia A De Nolfo

Technology Areas

Primary:

- TX08 Sensors and Instruments
 - └ TX08.1 Remote Sensing Instruments/Sensors
 - └ TX08.1.1 Detectors and Focal Planes

Target Destination

Outside the Solar System